FABRIC SOFTENER SYSTEM AND METHOD FOR USE IN CLOTHES DRYER

RELATED APPLICATION

This application is a continuation-in-part of U.S. Patent Application Serial No. 10/119,343, filed April 8, 2002 in the name of J. Michael Ogden; Robert O. Stiens; Thomas J. Stiens; and Richard J. Stiens, entitled, "Fabric Softener System and Method for Use in Clothes Dryer," which is assigned to the same assignee as this invention.

FIELD OF THE INVENTION

This invention relates to a system and method for softening fabrics, and, more particularly, to the combination of a liquid fabric softening composition and a substrate which is effective to absorb the composition, retain it in liquid form therein and release an effective amount of the composition into clothing within a clothes dryer in the course of a drying cycle to impart softness to the articles of clothing.

BACKGROUND OF THE INVENTION

The treatment of fabric with certain types of chemical compounds to impart softness when washing articles of clothing has been commonly employed in households, commercial laundromats and in the textile industry. The term "softness" refers to a quality of

the fabric in which its "hand" or feel to the touch is smooth, pliable and fluffy, as distinguished from coarse or scratchy. In addition to softening agents, chemical compounds used in washing clothing often include anti-static agents to reduce the static cling of the fabric. The term "static cling" refers to the tendency of articles of clothing to adhere to one another after being dried in a clothes dryer as a result of static electrical charges created on the surface of the fabric. Such electrostatic charges can also attract lint and dust to the fabric. The treatment of articles of clothing with softening agents and anti-static agents increases their comfort when worn, and generally reduces wrinkles which makes ironing easier.

There are generally two types of treatment systems for imparting softness and anti-static properties to laundered articles. One system is a liquid fabric softener of the type such as commercially available from The Proctor & Gamble Company of Cincinnati, Ohio under the trademark Downy®. Liquid fabric softeners of this general type are comprised of cationic compounds, and particularly quaternary ammonium and imidazolinium salts, in the form of liquid emulsions. They are introduced into the washing machine and added to the clothing during the rinse cycle.

Although effective in imparting softness and reducing static cling, liquid fabric softeners have a number of deficiencies. One limitation is that they are inconvenient to use. Often sold in relatively large and heavy containers, liquid fabric softeners must be poured into the relatively small cap of the container, a cup or other measuring device to obtain the proper quantity for a particular size load of wash. The liquid softener is then poured into a receptacle in the washing machine where it is held until the rinse cycle begins. It is easy to spill the liquid softener, both when measuring it and pouring into the washing machine, and then one needs to clean the cap or other measuring device after use.

Another problem with liquid fabric softeners is that the entire content of the washing machine is subjected to the softening agent when it is applied in this fashion. It may be desirable to soften only some of the clothes being washed in a particular washing cycle, but in order to do that the clothing must be separated beforehand and additional loads of wash run. This is not only inefficient but uses additional energy and water.

A still further deficiency of liquid fabric softeners is their effect on the flammability of clothing items. According to tests conducted by *Consumer Reports*, liquid fabric softener added to the rinse water in washing machines accelerates the burn rate of most fabrics tested. For example, in one test, a terry-cloth bathrobe laundered with liquid fabric softener took just 1.9 seconds to burn a five inch path whereas the same fabric without the fabric softener took 13 seconds to burn the same five inch path. Although the rate of burn varies with the type of fabric, seconds count when clothing catches fire.

The second method of imparting softening and anti-static properties to laundered clothing involves the use of "dry dryer sheets," i.e. sheets of nonwoven material impregnated with a composition usually consisting of a cationic softening agent, antistatic agents, dispersing agents and a fragrance. The softening agent is applied to the nonwoven material and then dried in an oven so that it is completely "dry" when ready for use. One or more dry dryer sheets are placed into a rotary clothes dryer with freshly laundered, wet items of clothing, where they remain for the entire drying cycle. The composition on the sheet of nonwoven material is released in the course of the drying cycle as a result of the heat within the clothes dryer, the moisture in the clothing and contact with the clothing induced by the tumbling action of the rotary dryer.

Although much more convenient to use than liquid fabric softeners, the dry dryer sheets described above also have a number of limitations. First, dry dryer sheets exhibit relatively poor softening capability compared to liquid fabric softeners. One reason for this is that dry dryer sheets depend to a large extent on physical contact with the clothing within the dryer during the drying cycle in order to effectively transfer the softening composition to the clothes. If the dryer sheet becomes trapped within the sleeve of a shirt, a pant leg or the like, it cannot make contact with other articles of clothing within the dryer. Even if the dry dryer sheet freely contacts the clothing during a drying cycle, the softening agent it carries does not penetrate the fabric to the same extent as liquid fabric softener in the rinse cycle of the washing machine.

Another limitation of dry dryer sheets is that a relatively high temperature is required in order to activate the softening agent on the nonwoven sheet and release it into the fabric of the clothing. Most clothes dryers have several heat settings to accommodate different types of clothing. For example, delicate fabrics are preferably dried at lower heat settings and temperatures than clothing made from cotton or the like. At lower heat settings, dry dryer sheets are of marginal effectiveness and therefore delicate fabrics or other clothing dried at lower temperatures may not exhibit the desired softness and feel when worn. This is a pervasive problem in many European countries, as well as other countries around the world, where the high cost of energy makes it a necessity to operate clothes dryers at lower temperatures. On the other hand, it has been observed that clothing dried at high heat settings and temperatures often exhibit an increased amount of static cling and wrinkling. This is true even when the dry dryer sheet is provided with anti-static agents. Furthermore, in addition to creating static cling and

wrinkling, high drying temperatures are hard on fabrics, tending to break them down over time.

SUMMARY OF THE INVENTION

A fabric softening system is provided comprising a liquid fabric softening composition which is retained in liquid from within a substrate, preferably the fibers of a sheet of nonwoven material, and then the moist sheet is introduced into a rotary clothes dryer with laundered, wet clothing where an effective amount of the softening composition is released into the fabric of the articles of clothing to impart softness to the articles of clothing.

In one presently preferred embodiment, the liquid fabric softening composition is a liquid comprising a softening agent in the form of a cationic surfactant, an amount of a preservative effective to prevent biological degradation of the composition and the substrate, a fragrance, and a liquid carrier. The composition is introduced into a substrate which is preferably a sheet of absorbent nonwoven material, although other liquid absorbent materials may be utilized such as woven material, open cell foam, sponge and others. The nonwoven material preferably includes highly absorbent fibers capable of absorbing many times their weight in liquid, alone or a blend of absorbent and non-absorbent fibers. The composition is sprayed, dipped or otherwise applied to the nonwoven sheet so that it is retained in liquid form by the absorbent fibers thereof, and then the moist sheets are packaged in an air tight container. A moist, nonwoven sheet is placed into the interior of a rotary clothes dryer, with wet, laundered clothing, for the duration of a normal drying cycle wherein an effective amount of the liquid fabric softening composition is released into the fabric of the clothing to impart softness.

A number of important advantages are obtained with the liquid fabric softening system of this invention compared to the prior art. Unlike liquid softening compositions introduced into the washing machine, the nonwoven sheet of this invention is extremely easy and convenient to use – no measuring, no spilling, no heavy container to pour from, no clean up of a measuring cap or cup and no need to separate clothing before washing according to what items are to be softened or not. Further, the fabric softening composition employed in the present invention does not increase the flammability of fabric, which is of particular concern with many liquid fabric softeners currently offered on the market.

Other advantages of the present invention highlight the deficiencies of "dry" dryer sheets now being sold such as the Bounce® dry dryer sheets available from The Proctor & Gamble Company of Cincinnati, Ohio. It has been found that the liquid fabric softening composition applied to the nonwoven sheet according to the present invention is readily released into the fabric of clothing within a clothes dryer operated at ambient temperature, comparatively low heat settings or high heat settings. Unlike dry dryer sheets which are activated only at high temperatures, the liquid fabric softening composition of the present invention is effective to soften any type of fabric at ambient temperatures or lower heat settings thus reducing static cling, wrinkling and damage to the fabric. It is believed that the mechanism for imparting the liquid fabric softening composition of this invention involves a wicking action along the surfaces of the wet clothing in the dryer. As noted above, the liquid fabric softening composition is maintained in liquid form within the nonwoven sheet. The clothing placed in the dryer is wet with water from the rinse cycle of the washing machine. When the liquid fabric softening composition comes into contact with the wet clothing in the dryer, it is wicked or transferred along the surface of the clothing by the water

in the clothing. The substrate or nonwoven sheet carrying the liquid fabric softening composition need not physically contact a substantial area of the surfaces of the clothing due to such wicking action, unlike dry dryer sheets, in order to impart an effective amount of softening agent to the fabric of the clothing. This increases the efficiency of the softening system of this invention, compared to dry dryer sheets and promotes even distribution of the liquid fabric softening composition throughout the clothing within the dryer.

DETAILED DESCRIPTION OF THE INVENTION

The fabric softening system of this invention comprises the combination of a liquid fabric softening composition and a substrate capable of retaining the composition in liquid form therein. The substrate is introduced into a clothes dryer with wet, laundered clothing wherein the composition is released into the fabric of the clothing to impart softness. Each component of the system of this invention is described separately below, followed by illustrative examples.

Liquid Fabric Softener Composition

The liquid fabric softener composition of this invention is prepared by mixing, in desired proportions, the following: (a) a softening agent; (b) a preservative; (c) a fragrance; and (d) a liquid carrier.

The softening agent is a cationic surfactant, preferably stearamidopropyl morpholine lactate which is commercially available under the trademark "Mackalene 326" from the McIntyre Group Ltd. of University Park, Illinois. It has a CAS number of 55852-14-7 and the following chemical formula:

$$C_{28}\ H_{56}\ N_2\ O_5$$

The material has a boiling point of approximately 100°C, a specific gravity of 1.01, a vapor pressure of approximately 25 mm Hg., a vapor density greater than 1 and an evaporation rate of greater than 1. It is soluble in water. In the presently preferred embodiment, the Mackalene 326 cationic surfactant is specifically manufactured to exhibit a pH in the range of 3.5 to 5.5, and most preferably in the range of 4.0 to 4.8. The cationic surfactant is present in the composition in an amount preferably in the range of about 10% to 99%, more preferably in the range of about 30% to 40%, and, most preferably in an amount of about 38%, by volume.

In order to ensure that no biological degradation occurs in the composition, or in the nonwoven sheet carrying the composition, a preservative is included. One preservative suitable for this purpose is dimethylol dimethyl hydantoin which is commercially available under the trademark "Glydant" from Lonza, Inc. of Fair Lawn, New Jersey. The preservative is present in the composition in an amount preferably in the range of about 0.20% to 0.80%, more preferably in the range of about 0.25% to 0.45% and most preferably in an amount equal to about 0.30%, by volume.

A number of different fragrances can be employed in the composition to create the desired smell of the clothing softened by the present invention, including, without limitation, rose oil, lavender, lilac, jasmine, vanilla, wisteria, lemon, apple blossom or compound bouquets such as citrus, spice, aldehydic, woods, oriental, baby powder and others. One fragrance suitable for use in the composition is sold under the name Baby Fragrance [C-78-17-B] commercially available from Bell Flavors and Fragrances, Inc. of Middletown, New York. The fragrance is present in the composition in an amount preferably in the range of about 0% to 2.5%, more preferably in the range of about 0.5% to 1.5% and most preferably in an amount of about 1%, by volume.

The liquid carrier is preferably deionized water, although the use of water which is not deionized is acceptable. The liquid carrier is present in the composition in an amount preferably in the range of 20% to 90%, more preferably in the range of about 55% to 65% and most preferably in an amount of about 60% by volume.

Substrate

The liquid fabric softener composition is carried by a substrate to form the fabric softening system of this invention. In the presently preferred embodiment, the substrate is formed of a sheet of nonwoven material, although it is contemplated that other materials capable of carrying liquid can be utilized including woven material, foam material, especially open cell foam material, sponge and similar materials.

Nonwoven material is particularly suited to the present application due to its relatively low cost, ease of processing, biodegradation capability and ability to absorb moisture. One presently preferred nonwoven material is fabricated using well known hydroentanglement technology from fibers sold under the "Tencel" trademark which are commercially available from Courtaulds Fibers, Inc. of Axis, Alabama. Tencel fibers are manufactured from a solvent spinning process in which wood pulp and amine oxide solution are mixed and heated until the cellulose dissolves. The resulting solution is then extruded into a dilute aqueous solution of the amine oxide, which precipitates the cellulose as fibers. The Tencel fibers exhibit a dry tensile strength in excess of other man-made cellulosic fibers and many synthetics, and have a tensile strength when wet of about 85% of its dry tensile strength. Such fibers absorb liquid up to about 800% of their dry weight, and

therefore provide a highly liquid absorbent substrate when hydroentangled to form a nonwoven sheet.

As noted above, the liquid fabric softener composition is described as being "carried" by a substrate and then released into the fabric of clothing during a drying cycle within a clothes dryer. The term "carried" is meant to broadly refer to substrates which absorb liquid, as well as those which exhibit adsorbent properties but nevertheless become wetted when brought into contact with liquid.

It is believed that absorbent materials, and particularly nonwoven materials formed of Tencel fibers or other highly absorbent fibers, effectively release the liquid fabric softening composition of this invention into the fabric of clothing within a clothes dryer. Highly absorbent fibers of this type trap or retain the composition in liquid form within the structure of the fibers, and then release the composition during the course of a drying cycle onto the wet clothes in the dryer. As noted above, it is believed the moisture on the wet clothes wicks or transfers the composition substantially uniformly throughout the clothing, and, therefore, the clothing is uniformly "softened." Importantly, transfer or wicking of the composition along the wet clothing is not dependent on, and can occur independently of, the application of heat within the clothes dryer, i.e., at ambient temperatures. As a result, the composition is relatively uniformly released into the fabric of the clothing to distribute the composition more evenly and completely to every article of clothing within the dryer.

It is contemplated that other materials which can "carry" liquid would also be useful in the practice of this invention. For example, nonwoven materials formed of a blend of adsorbent fibers and adsorbent, synthetic fibers such as polyester are capable of effectively "carrying" liquid. Although polyester and other absorbent fibers do not absorb, liquid can be retained in between such fibers and

is readily released from them. One presently preferred nonwoven blend consists of 65% rayon cellulosic fibers (absorbent) and 35% polyethylene terephthalate fibers (adsorbent).

An important aspect of this invention is that the liquid fabric softener composition is "carried" and retained in liquid form by the substrate. The term "liquid form" in the context of the present invention refers to the generally understood state of a fluid in which the fluid has a definite volume without a definite shape except that temporarily given by a container or the like. "Liquid form" does not mean a gel or gelled, or the state of a substance in which it is not flowable. The composition of the present invention is applied and retained in "liquid form" within the substrate in the sense that it has a definite volume, assumes the shape of the substrate and can be wicked or transferred into and along the wet fabric of articles of clothing within a clothes dryer during the course of a drying cycle to effectively impart softness.

EXAMPLE I

The liquid fabric softening composition was made as follows. A 114 liter drum was charged with 69.51 liters of deionized water at ambient temperature. A container of stearamidopropyl morpholine lactate was checked for uniformity, and then 44.04 liters of same was slowly blended with the water by gentle agitation and stirring. The resulting mixture was checked for pH level, and finding it was within acceptable limits, 1.17 kilograms of Baby Fragrance [C-78-17-B] and 340 milliliters of preservative ["Glydant" preservative] were added until fully dispersed.

EXAMPLE II

The mixture prepared in accordance with Example I was applied at ambient temperature to a continuous sheet of nonwoven

material formed from hydroentangled "Tencel" fibers. The nonwoven sheet was approximately six inches in width, and was transferred by a conveyor beneath a number of spray nozzles connected to a container filled with the mixture. The spray nozzles were operated to deliver the mixture at a rate effective to impregnate the Tencel fibers of the nonwoven material with a quantity of mixture equal to approximately 300% of the dry weight of each fiber. The impregnated nonwoven sheet was then cut into individual sections of approximately eleven inches in length, thus forming discrete nonwoven sheets of about six inches in width and eleven inches in length. The individual sheets were folded and placed in plastic tubs, which were then sealed.

The foregoing examples illustrate a preferred embodiment of the present invention, but it should be understood by those skilled in the art that various changes may be made and equivalents substituted for elements thereof without departing from the scope of the invention.

For example, the term "articles of clothing" has been used throughout to refer to items which are dried within the interior of a clothes dryer. It should be understood that such term "articles of clothing" is intended to be broadly construed as applying to other items which are commonly dried in a clothes dryer, including, without limitation, sheets, towels, rugs and other items made of fabric. Additionally, the term "clothes dryer" or "rotary clothes dryer" refers to a rotary hot air dryer which includes a rotating drum within which articles to be dried are subjected to a flow of heated air typically at a temperature of about 40° C to 90° C.

Therefore it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out the invention, but that the invention

will include all embodiments falling within the scope of the appended claims.

Wherefore, we claim: